If there is more than one LSE filter 58, the LSE filters 58 are attached to a first filter wheel 68. The first filter wheel 68 is synchronized with the light source 44 such that the light source 44 is selectively actuated when the desired LSE filter 58 is positioned in the path of the light beam 54 as described above. Likewise, if there is more than one SE filter 66, the SE filters 66 are attached to a second filter wheel 70. The second filter wheel 70 is synchronized with the light source 44 such that the light source 44 is selectively actuated when the desired SE filter 66 is positioned in the path of the light beam 54. If there is more than one LSE filter 58 and more than one SE filter 66, then the first and second filter wheels 68,70 and the light source 44 are synchronized such that the light source 44 is selectively actuated when the desired LSE and SE filters 58,66 are positioned in the path of the light beam 54.

Referring to FIG.5, the second embodiment of the field illuminator 40 utilizes transmittance to produce an image. In the second embodiment of the field illuminator 40, measurement of the light transmission properties of the sample is accomplished by positioning a white light source 44 and a first lens 56 under the sample residing within the chamber 20 and directing the light through the chamber first wall 30 (which is transparent in this embodiment), the sample, the chamber second wall 32, the objective lens 52, the SE filter 66, the second lens 67, and thereafter to the image dissector 42. The transmittance light is intermittently energized as transmittance measurements are required. The light source 44 may be pulsatile, such as from a flash tube, or it may be an incandescent bulb with a means for selectively exposing the sample to the light such as a shutter, or an electronic switch that extinguishes the light entirely.

The preferred image dissector 42 is a charge couple device (CCD) capable of providing at least eight bits of resolution and preferably twelve bits of resolution per pixel. The image dissector 42 converts an image of the light passing through the SE filter 66 into an electronic data format which can be seen and/or interpreted in real-time or at a subsequent time using a data file version of the image. The image can be interpreted manually by a technician, or with

the use of analytical software. An image dissector 42 other than a CCD may be used to convert the image of light into an electronic data format alternatively.

Referring to FIG.6, as used herein the term "volume" for volume of the field can mean the volume itself, or can refer to the through-plane thickness 78 of the imaged field because one can be readily determined from the other given the cross-sectional area of the field. As used herein, the term "through-plane thickness" refers to a line of sight that corresponds to the shortest distance 78 between the interior chamber surface 80 of the first wall 30 and the interior chamber surface 82 of the second wall 32.

Referring to FIGS. 3 and 4, in a first embodiment of the means for determining the volume of one or more fields within the sample, the label reader 38 reads the container label 28 which communicates the chamber 20 geometry to the apparatus 10 and with that information the volume of the field can be determined. For example, if the label 28 provides the slope values of the chamber first wall 30 and second wall 32 and a through-plane thickness 78 value at a known spatial location, the volume of a field at any position within the chamber 20 can be determined provided the slope values are constant for both walls 30,32 for the entire chamber 20.

In a second embodiment of the means for determining the volume of one or more select fields within the sample, the volume is determined by sensing the colorant signal from a sample field of unknown volume containing fluid sample having a known colorant concentration. The colorant signal magnitude to colorant concentration ratio is communicated to the apparatus 10 through the container label 28 and label reader 38. As used within this specification, the term colorant is defined as any reagent that produces a sensible signal by fluorescent emission, or by absorption of light at a specific wavelength, that can be quantified by the apparatus 10. The signal magnitude to colorant concentration may also be determined by comparison with a second known material such as a pad 34 of material with stable characteristics which is referenced by the apparatus 10 and used to calibrate the response of the colorant.

In a third embodiment of the means for determining the volume of one or more select fields, the volume is determined by comparing colorant signal from at least two sample fields. The first and second sample fields contain colorant of unknown concentration uniformly distributed within the fluid sample. The first field, referred to here as the calibration field contains a geometric characteristic-type feature of known height or volume. Examples of geometric characteristics include a step, a cavity, or a protuberance of known height or volume within one or both walls, or an object of known volume. The volume or height of the geometric characteristic is provided to the Programmable Analyzer 16 through the container label 28 and label reader 38. The change in sensible signal due to the displacement of colorant by the known geometric characteristic in the calibration field is measured through the field illuminator 40, and a calibration value of change in sensible signal per volume is calculated by the Programmable Analyzer 16 and stored. To determine the volume of the second, or unknown field, the Programmable Analyzer 16 takes the signal measured from the second field and multiplies it by the signal/volume ratio of the calibration field to arrive at a volume for the second field. This method of volume determination is further described in United States Patent No. 6,127,184.

In a fourth embodiment of the means for determining the volume of one or more select fields, the volume of the field(s) is determined using interferometric techniques to measure the through-plane thickness. The hardware necessary to perform the interferometric techniques includes a monochromatic light source and a beamsplitter which operate together to form interference patterns, where the number of observable interference fringes is related to the separation of the chamber walls 30,32.

In a fifth embodiment of the means for determining the volume of one or more select fields, the container chamber 30 includes specular surfaces on which a virtual reflected image may be detected by the apparatus 10. The specular surfaces are the two wall surfaces 80,82 in contact with the biologic fluid, or the outer surfaces if the wall thicknesses are known. The apparatus 10 detects the virtual reflected image on one of the specular surfaces and then